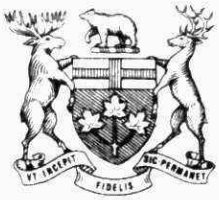

BOTTOM FAUNA SURVEY

OF LONG POINT BAY

IN THE NANTICOKE REGION

1969 to 1971

Environment Ontario

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by
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Bottom Fauna Survey of Long Point Bay in the Nanticoke Region - 1969 to 1971.

INTRODUCTION

As a result of proposals for extensive industrial development concentrated in the Nanticoke area, the pre-operative collection of biological water quality data was initiated by the Biology Section of the Ministry of the Environment early in the spring of 1969. These biological studies, encompassing bottom fauna and phytoplankton evaluations, were designed to complement additional field investigations by the Water Quality Surveys Branch, the Steel Company of Canada and the Hydro Electric Power Commission which were established to define physico-chemical characteristics, as well as zooplankton and fish population assessments carried out by the Ministry of Natural Resources.

This report summarizes bottom fauna data collected from the Nanticoke region during the period from 1969 to 1971 inclusive. It is a documentation of bottom fauna associations at eight sampling sites in the immediate vicinity of Nanticoke prior to the initiation of industrial operations.

DEVELOPMENT AT NANTICOKE

Industries scheduled to locate in the Nanticoke area include the Steel Company of Canada (Stelco), Texaco Canada Ltd., and the Hydro Electric Power Commission. The fossil-fuelled Nanticoke Generating Station will have a capacity of 4,000,000 kilowatts upon completion in November 1974. Approximately 2.16 Mgpm of cooling water will be discharged at a temperature elevated 15°F above the background lake condition. The first of eight generating units commenced operation in June, 1972. Texaco Canada Ltd. plans to construct a 50,000 barrel-per-day refinery which may be expanded to an ultimate production capacity of 100,000 barrels per day. At present, plans for the steel refinery proposed by Stelco have been postponed indefinitely. The plant was to have produced 3.8 million tons of steel per year.

BIOLOGICAL ASSESSMENT OF WATER QUALITY

A study of bottom fauna associations permits assessment of the effect of waste discharges on important fish-food organisms and indicates the quality of the aquatic environment over extended time intervals. Benthic populations are virtually sedentary (unlike fish) and are less

prone to exhibit diurnal and seasonal variations of the same magnitude as phytoplankton and zooplankton populations.

To assess environmental quality, a comparison of variety and total numbers of bottom fauna organisms at strategically-located sampling sites is utilized. A clean-water association is usually characterized by a wide variety of species with no outstanding numerical abundance of one group. When subjected to toxic wastes or adverse environmental conditions, benthic associations may become markedly depressed in both numbers and variety.

METHODS

Owing to the variable nature of the bottom and limits in time and manpower, artificial substrates rather than dredging techniques were employed to monitor benthic populations. These samplers consist of 8x8x6 inch wire cages filled with two-inch crushed limestone and are placed on the lake-bottom at each site. Thus, a substrate common to all stations is provided for habitation by organisms indigenous to the area over a suitable exposure period.

From early May through late October of each year, two artificial substrate samplers were placed at each of

eight stations which had been selected to reflect the effects of varying water quality conditions throughout the area (Figure 1). At approximate six-week intervals these samplers were recovered, the macroinvertebrates were collected and the substrates replaced. During the collection process, each stone was scrubbed to insure that all organisms were removed and that any organic accumulation (including algal growth) was eliminated.

In all cases, specimens were separated, preserved in 95% ethanol and returned to the London Laboratory where they were identified and enumerated. Most organisms were identified to the genus level although some were identified only to family. Others received more definitive identification to species. Identified groups at any of these three levels are hereafter referred to as taxa.

RESULTS

Of the 200 substrate samplers set over the 3-year period, data are available for 175. Table 1 indicates that while only two samplers were lost in 1969, 11 & 12 were lost in 1970 and 1971, respectively. At station 5016, eight of 24 samplers set were lost while 5 were lost at 518. Losses were the result of public mischief, accelerated construction activity at the Nanticoke site and the elements.

Table 1: Recovery success of samplers placed at 8 stations in the Nanticoke region (1969-1971)

Year	Number of Substrates			Missing Stations
	Set	Collected	Missing	
1969	64	62	2	5016(2)J.*
1970	64	53	11	994(1)O;5016(1)A,(1)S,(2)O; 810(2)A;518(2)A,(1)S; 112(1)O.
1971	72	61	12	5008(1)A;5016(1)J,(1)O; 518(1)J,(1)A; 648(2)O; 112(1)J,(1)A; 501(2)A; 1040(1)S.
TOTALS	200	175	25	5016(8); 518(5);112(3); 810(2); 648(2); 501(2); 994(1); 5008(1);1040(1).

*J- June
A-August
S-September
O-October

Data summarizing the numbers and types of organisms collected from each station over the three-year period are

presented in Table I of the Appendix.

Qualitatively, the sampling of the original eight stations from 1969-71 yielded a total of 42 invertebrate taxa plus three species of vertebrates. An additional six invertebrate and two vertebrate taxa were collected from station 1040 which was sampled only in 1971. A station-to-station summary of variety of invertebrates occurring over the three-year sampling interval is provided in Table 2.

Table 2: Annual numbers of invertebrate taxa collected at nine stations in the Nanticoke region (1969-1971).

Year \ Station	994	5008	5016	810	518	648	112	501	1040	Total
1969	17	15	17	19	17	14	16	19	-	31
1970	19	18	14	13	15	16	13	19	-	32
1971	18	19	16	19	16	14	18	12	24	37
No. Different Taxa	25	24	22	25	20	16	19	26	24	48

Total numbers of taxa per station ranged from 16 at station 648 to 26 at station 501.

The amphipod Gammarus, the crayfish Orconectes, and the mayfly Stenonema were among 10 species which occurred at virtually all sampling sites each year (Table 3.) Also, the snails Goniobasis, Physa, Bulimus and

Table 3 : Percentage occurrence of benthic organisms at eight sampling sites in the Nanticoke region from 1969 to 1971 inclusive.

% Occurrence	No. Stations	Taxa
92-100	22-24	Gammarus (24), Orconectes (24), Goniobasis (24), Physa (24), Cottus (24), Stenonema spp (23), Cryptochironomus (23), Asellus (22), Bulimus (22), Amnicola (22).
79-88	19-21	Polycentropus (21)
67-75	16-18	Stenonema tripunctatum (18), Sphaerium (17)
54-63	13-15	Crangonyx (15)
42-50	10-12	Microtendipes (10), Cambarus (10)
29-38	7-9	Helisoma (8), Athripsodes (8), Pisidium (8)
17-25	4-6	Lirceus (5), Ephemerella (4), Somatogyrus (4), Limnodrilus (4)
17	4	Chironomus (3), Dicrotendipes (3), Lymnaea (3) Glossiphonia (3), Pentaneura (2) Valvata (2), Helobdella (2), Stenelmis (1), Paragyractis (1), Caenis (1), Cheumatopsyche (1), Tanytarsus (1), Endochironomus (1), Paratendipes (1), Hyallela (1), Pseudochironomus (1), Pontoporeia (1), Lampsilis (1), Potamothrix (1)

Amnicola, the caddisfly larva Polycentropus and the mayfly Stenonema tripunctatum were common. Some species such as Helicopsyche, Leptocella, Stictochironomus and P.vejdovskyi were found only at station 1040. The isopod Lirceus was common at station 518 each year but was found (although rarely) at only two other sites. Crangonyx and Cambarus were found together each of the three years only at station 648.

Quantitative Aspects:

Annual average numbers of macroinvertebrates collected at each station from 1969 to 1971 inclusive are summarized in Table 4.

Table 4: Annual average numbers of macroinvertebrates collected from artificial substrates at nine stations in the Nanticoke region (1969-1971).

Station / Year	994	5008	5016	810	518	648	112	501	1040	Annual Mean
1969	153	208	830	163	146	53	160	349	-	258
1970	176	184	271	126	77	101	144	169	-	156
1971	218	210	443	136	166	62	164	188	196	198
Mean	182	200	508	143	134	73	157	239	196	

Annual average numbers of invertebrates per station ranged from 156 to 258 with the least and most productive years being 1970 and 1969 respectively. The fact that incidence of sampler losses were highest in 1970 and lowest in 1969 may partially have influenced these results.

Quantitative data were subjected to a log transformation to normalize distribution. Pertinent statistical data for each station are provided in Table II of the Appendix and detailed analyses are available. Analysis-of variance among year-to-year means at each station indicated no significant difference at the 95 percent confidence level.

Each year, considerably higher numbers of macroinvertebrates were found at station 5016 (508 organisms per year average) than at other stations. Lowest average numbers of organisms (73) were consistently found at station 648. At the remaining sites, annual average numbers of macroinvertebrates occurring on the samplers fell within the 100-200 range.

Seasonal Variation:

Both abundance and variety of organisms varied seasonally (Table 6). For the period 1969-71 means for the four sampling intervals at all stations but 518 were significantly different from the overall station mean. Monthly average

numbers of macroinvertebrates per station were highest in June (280 organisms per station) and lowest in August (156 per station). In 13 of 18 station-to-station comparisons over the three years (Table 7), June exhibited greatest numbers while August, September and October ranked similarly in least abundance.

Table 6 - Seasonal variation in average numbers of taxa and organisms at eight stations in the vicinity of Nanticoke (1969-1971).

Sample Period	Average No. Taxa per station	Average No. Organisms per station
June	10.1	280
August	9.2	156
September	10.8	187
October	10.6	165

August also ranked last in 13 of 18 comparisons of variety of taxa at the sampling stations, consistent with its overall average of 9.2 taxa per station. In contrast, September and October exhibited greatest variety during the three-year period (10.8 & 10.6 taxa per station respectively),

consistent with their rankings in Table 7.

Table 7: Seasonal frequency-of-occurrence of numbers and types of macroinvertebrates in order of rank at eight * stations in the vicinity of Nanticoke (1969-1971).

RANKING	FREQUENCY-OF-OCCURRENCE			
	June	August	September	October
Abundance				
I (Most)	13	2	1	2
II (next highest)	2	5	5	6
III (" "	1	6	6	5
IV (least)	2	5	6	5
Variety				
I (most)	5	3	11	8
II (next highest)	5	2	3	4
III (" ")	4	0	4	3
IV (least)	4	13	0	3

* Only those stations for which annual data is complete (18 of 24)samples are included.

Several species exhibited seasonal variation in numbers as is evident in Table 8. Only those taxa whose monthly ranking in average numbers corresponded to their ranking at over 50 percent of the stations are included. A rough indication of life histories of some macroinvertebrates

in the Long Point Bay Region is provided by this information. Larvae of the mayfly Stenonema and the caddisfly Polycentropus were most abundant during autumn, emergence as adults taking place in early summer. Numbers of the midge larva Cryptochironomus and the amphipod Gammarus were consistently highest in the early summer over the three-year period although Gammarus was relatively abundant during all seasons.

Table 8: Macroinvertebrates varying seasonally at eight sampling sites at Nanticoke 1969-71 (average numbers per station)

ORGANISMS	JUNE	AUGUST	SEPTEMBER	OCTOBER
Stenonema spp.	6	4	6	23
S.tripunctatum	<1	0	2	3
Polycentropus	1	<1	9	10
Cryptochironomus	8	21	<1	0
Gammarus	224	72	50	33
Physa	2	2	5	14
Planariidae	18	24	79	48

Variation Between Stations:

To qualitatively compare benthic associations from station to station, the coefficient of similarity was utilized. This method provides an indication of the degree to which the species composition at one station is similar to that at another. Coefficients for all stations for each of the three years are provided in Table III of the Appendix.

Based on a list of taxa found at each station over the three-year period (Table I of the Appendix) data on qualitative similarity of macroinvertebrate associations are depicted in Table 9 of the text. Generally, benthic associations were very similar qualitatively from station to station and the average value of the 28 coefficients was .74.

Table 9 - Qualitative similarity * of macroinvertebrate associations among 8 stations in the vicinity of Nanticoke (1969-71).

	501	112	648	518	810	5016	5008	994
994	.67	.73	.73	.71	.72	.72	.73	
5008	.68	.74	.75	.77	.69	.74		
5016	.79	.83	.75	.76	.94			
810	.78	.77	.63	.71				
518	.70	.82	.78					
648	.62	.80						
112	.76							
501								

* Coefficient of similarity = $\frac{2 \text{ (No. taxa common to A \& B)}}{\text{No. taxa at A + No. at B}}$

Although all coefficients were reasonably high, it is worthy of note that values at stations 501 and 810 fell below .70 in 3 of 7 and 2 of 7 comparisons respectively. Average coefficient values (Table 10) for station 501 were consistently below the annual average for each year as were values for 810 in 1969 and 1970.

Table 10: Average coefficients of similarity for eight stations in the Nanticoke vicinity (1969-1971)

Year \ Station	501	112	648	518	810	5016	5008	994	Annual Average
1969	.75	.78	.80	.72	.73	.78	.82	.77	.77
1970	.65	.76	.78	.78	.70	.75	.73	.77	.74
1971	.71	.80	.74	.81	.83	.81	.81	.75	.75
OVERALL	.71	.78	.72	.75	.75	.79	.73	.72	.74

Seven genera (e.g. Pseudochironomus, Lirceus, Lampsilis) were found rarely anywhere but at station 501 while four genera were virtually unique to station 810.

Although station 518 appeared qualitatively dissimilar from other stations in 1969 its index of similarity was high in succeeding years.

CONCLUSIONS

1. Data for 175 of the 200 artificial substrate sample sets are complete. Loss of samples as a result of construction activity, public mischief and the elements may have influenced quantitative results at two stations (5016 and 518) during 1970 and 1971.
2. From the original eight stations, a total of 42 different invertebrate taxa plus three species of vertebrates were collected during the three-year period. An additional six invertebrate and two vertebrate taxa were found at a sampling site in close proximity to the Nanticoke Generating Station discharge channel. Total numbers of taxa per station ranged from 16 to 26.
3. Annual average numbers of invertebrates per station ranged from 156 in 1970 to 258 in 1969. Year-to-year means for the period from 1969 to 1971 at each station did not vary significantly.
4. Each year, lowest average numbers of macroinvertebrates were found at station 648 (average of 73 organisms per year) while considerably higher numbers were consistently found at station 5016 (508 organisms per year).
5. Numbers of organisms were shown to vary seasonally. Seasonal average numbers of macroinvertebrates were consistently highest in June over the three-year period and lowest in August. September and October exhibited greatest

variety while least variety usually occurred in August. Numbers of several species varied seasonally.

6. Although benthic associations at all stations were qualitatively very similar, indices of similarity for stations 501 and 810 appeared lower than normal.

FUTURE CONSIDERATIONS

During the 1972 survey season an attempt will be made to establish an areal estimate of standing stock of benthic organisms at each station using a Ponar dredge. Along with the regular artificial substrate monitoring program, two dredge hauls will be made at each station once every six weeks, time and bottom conditions permitting.

APPENDIX

Table I — Average numbers of organisms collected at nine stations in the Nanticoke region of Long Point Bay (1969-71)

Table II — Statistical data for quantitative bottom fauna information collected from 8 sampling sites in the vicinity of Nanticoke, Long Point Bay (1969-71) following log transformation.

Table III — Degree of similarity in species compostion of bottom fauna among eight stations in the Nanticoke region (1969-71) using the coefficient of similarity.

Table 1 - Average numbers of organisms collected at nine stations in the Nanticoke region of Long Point Bay (1969-71).

ORGANISMS	STATIONS								
	994	5008	5016	1040*	810	518	648	112	501
MAYFLIES									
Caenis	P								
Ephemerella		P				P			
Stenonema spp.	15	15	2	11	20	23	1	P	1
S. tripunctatum	2	2	P	2	2	4	P	P	
CADDISFLIES									
Athripsodes		P	P		1	P		P	P
Cheumatopsyche							P		
Helicopsyche				P					
Leptocella				P					
Polycentropus	13	5	1	3	17	4	2	P	P
unident.				P					P
LEPIDOPTERA									
Paragyractis								P	
MIDGES									
C.(Chironomus)			P		P				P
C.(Cryptochironomus)	17	25	1		8	1	1	1	1
C.(Dicrotendipes)	P				P				
C.(Endochironomus)		P							
Microtendipes	P	P	1	P	1				P
Paratendipes		P							
Pentaneurini (unident)				P					
Pentaneura	P	P							
Procladius				P					
Pseudochironomus				1					P
Stictochironomus				P					
Tanypodinae unident		1							
Tanytarsus	P								
unident. pupae	1	P	P	P	1	P		P	P

Table 1 - continued

ORGANISMS	STATIONS								
	994	5008	5016	1040*	810	518	648	112	501
BEETLE									
Stenelmis						P			
ISOPODS									
Asellus militaris	1	1	21	4	1	1	4	13	11
Lirceus	P					1			P
AMPHIPODS									
Crangonyx	1	P	P		1	1	3	P	1
Gammarus fasciatus	94	124	173	122	57	49	15	82	174
Hyallela azteca	P								
Pontoporeia affinis									P
DECAPODS									
Cambarus robustus	P	1				P	P	P	P
C. (imm.)	P			P			P		P
Orconectes propinquus	3	2	2	2	4	3	3	2	3
O. (imm.)	P	P	1	1	3	1	P	P	P
CLAMS									
Lampsilis radiata									P
Pisidium	P		P	P	1			P	P
Sphaerium	1	1	P	P	1	P		P	1
SNAILS									
Amnicola	1	1	1	2	1	6	4	6	1
Bulimus tentaculatus	1	3	69	3	1	5	2	3	5
Goniobasis	1	8	1	1	3	14	16	P	3
Helisoma			P		1			P	1
Lymnaea	P	P					P		
Physa	3	4	2	1	1	9	18	3	4
Somatogyrus	P		P		P				
Valvata tricarinata				1					P
immatures			10		1	3	2	P	

Table 1 - continued

ORGANISMS	STATIONS								
	994	5008	5016	1040*	810	518	648	112	501
FLATWORMS									
Planariidae	28	7	223	37	17	9	2	47	33
LEECHES									
Glossiphonia			P		P	P			
Helobdella					P				P
WORMS									
Limnodrilus (imm.)		P	P	1	P				P
Potamothrix moldaviensis					P				
P. vejdovskyi				1					
Lumbriculidae				P					
MISC. VERTEBRATES									
Mud puppy			P						
Sculpins	2	1	3	2	1	2	P	2	4
Johnny darter					P				
Fantail darter				P					
Stone cat				P					
No. Taxa									
Invertebrates	25	24	22	25	25	20	16	19	26
Vertebrates	1	1	2	3	2	1	1	1	1
TOTAL TAXA	26	25	24	28	27	21	17	20	27
No. Organisms									
Inverts	182	200	508	196	143	134	73	157	239
Verts	2	1	3	2	1	2	-	2	4
TOTAL ORGANISMS	184	201	511	198	144	136	73	159	243

* Data collected for only 1 year (1971)

Table II - Statistical data for quantitative bottom fauna information collected from 8 sampling sites in the vicinity of Nanticoke, Long Point Bay (1969-71) following log transformation.

Station		1969	1970	1971	Overall
994	$\bar{x}$	2.05	2.23	2.24	2.17
	S^2	.11	.05	.10	.09
	S.E.	.12	.08	.11	.06
	N	8.0	7.0	8.0	23.0
5008	$\bar{x}$	2.11	1.98	2.15	2.08
	S^2	.20	.28	.12	.19
	S.E.	.16	.19	.12	.09
	N	8.0	8.0	8.0	24.0
5016	$\bar{x}$	2.81	2.40	2.57	2.62
	S^2	.13	.02	.05	.09
	S.E.	.15	.06	.09	.08
	N	6.0	4.0	6.0	16.0
810	$\bar{x}$	2.16	2.06	2.04	2.09
	S^2	.05	.05	.08	.06
	S.E.	.08	.09	.10	.05
	N	8.0	6.0	8.0	22.0

Table II - continued

Station		1969	1970	1971	Overall
518	$\bar{x}$	2.13	1.83	2.14	2.05
	S^2	.03	.08	.06	.07
	S.E.	.07	.13	.10	.06
	N	8.0	5.0	6.0	19.0
648	$\bar{x}$	1.66	1.86	1.75	1.76
	S^2	.04	.15	.03	.08
	S.E.	.07	.14	.07	.06
	N	8.0	8.0	6.0	22.0
112	$\bar{x}$	2.07	2.16	2.25	2.15
	S^2	.13	.03	.02	.07
	S.E.	.13	.07	.06	.06
	N	8.0	7.0	6.0	21.0
501	$\bar{x}$	2.15	2.16	2.25	2.18
	S^2	.39	.09	.03	.17
	S.E.	.22	.10	.07	.09
	N	8.0	8.0	6.0	22.0

Table 111- Degree of similarity in species composition of bottom fauna among eight stations in the Nanticoke region (1969-71) using the coefficient of similarity.

1969

994	.74	.74	.85	.67	.74	.78	.88
5008	.72	.85	.90	.82	.72	.82	
5016	.79	.80	.79	.72	.79		
810	.75	.76	.69	.68			
518	.68	.69	.79				.77
648	.74	.81					
112	.81						
501							
	501	112	648	518	810	5016	5008 994

1970

994	.70	.76	.86	.83	.74	.74	.77
5008	.67	.73	.78	.80	.64	.71	
5016	.69	.90	.75	.77	.67		
810	.57	.69	.81	.77			.74
518	.61	.80	.85				
648	.65	.77					
112	.65						
501							
	501	112	648	518	810	5016	5008 994

1971

994	.63	.74	.76	.72	.77	.81	.82
5008	.73	.82	.74	.86	.85	.84	
5016	.77	.81	.73	.80	.89		.75
810	.79	.92	.74	.86			
518	.73	.89	.81				
648	.64	.76					
112	.69						
501							
	501	112	648	518	810	5016	5008 994